IS 3660-11 (1989): Methods of Test for Natural Rubber, Part 11: Determination of Plasticity [PCD 13: Rubber and Rubber Products]

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IS 3660 (Part 11) : 1989
(Reaffirmed 2000)

Indian Standard

METHODS OF TEST FOR NATURAL RUBBER

PART 11 DETERMINATION OF PLASTICITY

NR : 12

(First Revision)

भारतीय मानक

प्राकृतिक रबड़ की परीक्षण विधियाँ

भाग 11 सुघट्यता का निर्धारण

एन आर : 12

(पहला पुनरीक्षण)

UDC 678·4·539·214

BUREAU OF INDIAN STANDARDS
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Price Group 2

FOREWORD

This Indian Standard (Part 11) (First Revision) was adopted by the Bureau of Indian Standards on 14 April 1989, after the draft finalized by the Rubber Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Methods of test for natural rubber had been originally covered in the following four parts of IS 3660:

Part 1 : 1972 Determination of dirt, volatile matter, ash, total copper, manganese, rubber hydrocarbon, viscosity (shearing disc viscometer), and mixing and vulcanizing of rubber in a standard compound (*first revision*)

Part 2 : 1968 Determination of solvent extract and nitrogen content

Part 3 : 1971 Plasticity and plasticity retention index

Part 4 : 1979 Determination of colour, accelerated storage-hardening test and vulcanization characteristics (MOD test)

While reviewing various test methods for natural rubber, the Committee decided to align them with the corresponding international standards. No unification of test methods for natural and synthetic rubber has been considered necessary. However, in revising test methods for natural rubber, the Committee had decided to revise and split the standard (IS 3660) in further parts and publish individual test methods under natural rubber (NR) series. For proper referencing of existing test methods and the new methods under revision, a table showing correspondence of various methods of test covered in the previous parts of IS 3660 (Parts 1, 2, 3, and 4) with the presently split parts *vis-a vis* the original NR : number have been given in the table given in Annex A.

In order to facilitate cross-reference, it has been decided to retain the original discrete NR series number assigned to various test methods as indicated in original IS 3660 (Parts 1, 2, 3, and 4) in the new revised parts of IS 3660.

The test method given in this revised standard supersedes the test method as given under NR : 12 of IS 3660 (Part 3) 1971. All the four parts of the original IS 3660 shall be withdrawn upon its complete revision.

In the preparation of this standard, assistance has been derived from ISO/DIS 2007-1988 'Rubber, unvulcanized — Determination of plasticity — Rapid plastimeter method', published by the International Organization for Standardization (ISO).

In the latest ISO/DIS, based on the work carried out in UK, the length of the platen of specified diameter has been increased and the depth of inclusion of other platen within the heating jacket has been specified as this could result in improvement of precision of rapid plasticity measurement. Accordingly, in the revision of this standard, the above modifications have been made.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*).'

Indian Standard

METHODS OF TEST FOR NATURAL RUBBER

PART 11 DETERMINATION OF PLASTICITY

NR : 12

(First Revision)

1 SCOPE

1.1 This standard (Part 11) prescribes a method for rapid determination of plasticity of the raw natural rubber.

NOTE — This method is also suitable for determination of plasticity of unvulcanized compounded rubber.

2 REFERENCE

2.1 The Indian Standard IS 3660 (Part 1) : 1972 'Methods of test for natural rubber : Part 1 Determination of ash, total copper, manganese, rubber hydrocarbon, viscosity (shearing disc viscometer), and mixing and vulcanizing of rubber in a standard compound (*first rivision*)' under revision as IS 3660 (Part 16) (NR : 17), is a necessary adjunct to this standard.

3 OUTLINE OF THE METHOD

3.1 A disc-shaped test piece is rapidly compressed between small parallel platens to a fixed thickness of 1 mm and held thus for 15 seconds to enable the test piece to reach approximate temperature equilibrium with the platens. It is then subjected to a constant compressive force for 15 seconds. Its thickness at the end of this period is taken as the measure of plasticity.

4 APPARATUS

4.1 Parallel Plate Plastimeter, consisting of the following elements:

a) *Two Parallel Circular Platens*

These shall have smooth flat surfaces and shall be movable in relation to each other, both provided with a suitable means of heating, and a jacket so that the material being tested and the area surrounding it may be maintained at the specified test temperature. One of the two platens shall be a right cylinder of stainless steel and shall have 7·3, 10·0 or 14·0 mm diameter (tolerance ± 0·02 mm); its effective depth shall be 4·50 ± 0·15 mm and care shall be taken to ensure that the edge of the working face is neither worn nor damaged. The diameter shall be selected so that the measured plasticity lies between 20 and 85. The other platen may be of chromium-plated brass and shall be of a larger diameter than the first platen. Its effective depth of inclusion within any heating jacket shall be 3·50 ± 0·25 mm.

b) *Means for Moving One or Other of the Two Platens Normal to its Surface*

These means shall compress the test piece to a thickness of 1·00 ± 0·01 mm. The mode of movement of the platen and the forces applied in this operation shall be such that, with or without the test piece in place, the movement is always completed within a period of 2 seconds. A force of at least 300 N is required and may be conveniently provided by the springs.

c) *Means of Applying a Test Force, to One or the Other Platen* 100 ± 1 N normal to its surface to compress the test piece.

d) *Means for Indicating the Thickness of the Test Piece*, to the nearest 0·01 mm when it is between the platens.

e) *Timing Device*, so that the test may be timed in seconds to an accuracy of 0·2 seconds.

4.2 Punch

The purpose of the punch is to produce test pieces of approximately constant volume quickly and without difficulty. The punch shall consist of a flat-ended cylindrical anvil and a coaxial tubular knife moving independently of one another; a single action of the handle shall compress a portion of the material to a thickness of approximately 3 mm and shall cut out a disc of approximately 13 mm diameter. The test piece need only be approximately constant in volume because the final shaping to exact dimensions is carried out in the instrument during the pre-heating period.

4.3 Tissue Paper

It shall be bleached, unglazed, acid-free tissue paper of approximately 17 g/m^2.

NOTE — For interlaboratory testing, paper from the same source shall be used.

5 TEST PIECE

5.1 Raw rubber shall be homogenized when comparative tests are to be carried out. The preparation and homogenization of the sample shall be effected in accordance with the method given in 3 of IS 3660 (Part 1) : 1972. The test piece shall be a disc of rubber approximately 13 mm in diameter and approximately 3 mm thick, having a volume of 0·40 ± 0·04 ml. If the specified thickness is attained by compressing an initially thicker sheet, the latter shall be not more than 4 mm thick.

6 CALIBRATION

6.1 The settings of the rapid plastimeter shall be checked against the maker's instructions. The loading spring shall be recalibrated (100 ± 1 N) every 6 weeks, and the timing unit (pre-heating time 15 $^{+1}_{-0}$ seconds, and test period 15·0 ± 0·2 s) every 4 weeks. The position of the top platen shall be checked before each test.

NOTE — A sample of butyl rubber* may be used to check whether the machine is in working order. The test pieces shall be prepared from a sheet of 3 to 4 mm thick, cut from the butyl rubber sample.

7 TEMPERATURE OF TEST

7.1 Unless otherwise stated, the test shall be carried out at 100 ± 1°C.

8 PROCEDURE

8.1 Place two pieces of tissue paper each 35 mm × 35 mm between the heated platens and set the thickness measuring device to zero when the platens are closed. Then insert the test piece (**5**) centrally between the two pieces of tissue paper, and place the whole between the heated platens. Compress the test peice to a thickness of 1·00 ± 0·01 mm, holding it in the compressed state for a pre-heating period of 15 $^{+1}_{-0}$ s. On completion of the pre-heating period, apply a test force of 100 ± 1 N to the movable platen for a period of 15·0 ± 0·2 s. At the end of this time, measure the thickness of the test piece. Take the reading of thickness at the moment the 15 seconds test period is completed. On models with electronic digital read-out, the measurements shall be held until the instrument is re-set. On instruments with dial gauge read out, the reading shall be taken immediately before any drop-back occurs, and before the locking mechanism operates.

9 REPORTING OF RESULTS

9.1 The median value of the thickness of three test piece at the end of the 15 s compression period, expressed in hundredths of a millimetre, shall be taken as the rapid plasticity number (mm/100 N).

10 TEST REPORT

10.1 The test report shall include the following information:

a) A full description and identification of the tested sample, including,
   1) its origin,
   2) preparation of test pieces, for example, procedure of milling, and
   3) details of compounded rubbers, if applicable;

b) Test method
   1) A reference to this standard, and
   2) Any special data concerning the apparatus;

c) Test details
   1) The size of platen used,
   2) The temperature of test;

d) Test results, the plasticity number, expressed as specified in **9.1**; and

e) Date of test.

*The rubber may be obtained from the National Bureau of Standards, Washington, USA (designation : NBS — 388) or from any other suitable source.

ANNEX A

(Ref : *Foreword*)

Table showing Correspondence of the various methods of test covered in the existing IS 3660 (Part 1) : 1972, IS 3660 (Part 2) : 1968, IS 3660 (Part 3) : 1971, and IS 3660 (Part 4) : 1979 with the revision/ proposed revision of all the four Parts of IS : 3660

Existing Test Methods			*Proposed Revision*		*Remarks*
Test Method	IS No.	Part (Series)	IS No.	Series	
NR SERIES					
Determination of dirt	IS 3660 : 1972	Part 1 (NR : 1)	IS 3660 (Part 1) : 1985	(NR : 1)	
Determination of volatile matter	IS 3660 : 1972	Part 1 (NR : 2)	IS 3660 (Part 2) : 1985	(NR : 2)	
Determination of ash	IS 3660 : 1972	Part 1 (NR : 3)	IS 3660 (Part 3) : 1988	(NR : 3)	
Determination of total copper	IS 3660 : 1972	Part 1 (NR : 4)	IS 3660 (Part 4) : 1988	(NR : 4)	
Determination of manganese	IS 3660 : 1972	Part 1 (NR : 5)	IS 3660 (Part 5) : 1989	(NR : 5)	
Determination of iron	IS 3660 : 1972	Part 1 (NR : 6)	Deleted since this test is no longer being done		
Determination of rubber hydrocarbon	IS 3660 : 1972	Part 1 (NR : 7)	IS 3660 (Part 6) : 1988	(NR : 7)	
Determination of viscosity by shearing disc viscometer	IS 3660 : 1972	Part 1 (NR : 8)	IS 3660 (Part 7) : 1988	(NR : 8)	
Mixing and vulcanizing in a standard compound	IS 3660 : 1972	Part 1 (NR : 9)	IS 3660 (Part 8)	(NR : 9)	Under revision
Determination of solvent extract	IS 3660 : 1968	Part 2 (NR : 10)	IS 3660 (Part 9) : 1989	(NR : 10)	
Determination of nitrogen content	IS 3660 : 1968	Part 2 (NR : 11)	IS 3660 (Part 10)	(NR : 11)	Under revision
Determination of plasticity	IS 3660 : 1971	Part 3 (NR : 12)	IS 3660 (Part 11) : 1989	(NR : 12)	
Determination of plasticity retention index (PRI)	IS 3660 : 1971	Part 3 (NR : 13)	IS 3660 (Part 12) : 1989	(NR : 13)	
Determination of colour	IS 3660 : 1979	Part 4 (NR : 14)	IS 3660 (Part 13)	(NR : 14)	Under revision
Determination storage-hardening test	IS 3660 : 1979	Part 4 (NR : 15)	IS 3660 (Part 14)	(NR : 15)	
Determination of vulcanization characteristics (M O D test)	IS 3660 : 1979	Part 4 (NR : 16)	IS 3660 (Part 15)	(NR : 16)	
Method for preparation of test samples	IS 3660 : 1972	Part 1 (clause 3)	IS 3660 (Part 16)	(NR : 17)	

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